

Menoua Keshishian

menoua.github.io | [GitHub](#) | [LinkedIn](#) | [Google Scholar](#) | menoua.k@columbia.edu

RESEARCH INTERESTS

Deep Learning, Speech Understanding, Digital Signal Processing (Biomedical, Audio), Neuroscience

EDUCATION

COLUMBIA UNIVERSITY | GRADUATE SCHOOL OF ARTS AND SCIENCES New York, NY
PhD in Electrical Engineering, Cumulative GPA: 4.07/4.00 Sep 2017—Expected Feb 2024

SHARIF UNIVERSITY OF TECHNOLOGY | SCHOOL OF ELECTRICAL ENGINEERING Tehran, Iran
BS in Electrical Engineering, Minor in Computer Science Sep 2012—Jul 2017

SKILLS

General - Research, Data Science, (Neural) Signal Processing, Software Engineering, Linear Algebra

Programming - Python, MATLAB, Rust, Java, C++, Bash, HTML/CSS, LaTeX

Machine Learning - Deep Learning, Automatic Speech Recognition, Natural Language Processing, Unsupervised Learning, Large Language Models, Developing custom networks and loss functions

ML Frameworks - NumPy, Pandas, Scikit-learn, PyTorch, TensorFlow, Keras, Hugging Face Transformers

Algorithms & Data Structures - Time and Space Complexity Analysis, Dynamic Programming, Recursion, BFS, DFS, Hash Function, Combinatorics, Heaps, Queues, Trees, Graphs, etc.

EXPERIENCE

COLUMBIA UNIVERSITY | GRADUATE RESEARCH ASSISTANT New York, NY
Advisor: Dr. Nima Mesgarani Sep 2017—Present

Interpretable modeling of speech processing in auditory cortex

- Developed a method to interpret the nonlinear mechanisms of neural processing of speech in the human auditory cortex using convolutional neural networks
- Research areas: computational neuroscience, deep learning, neural network function analysis

Temporal context analysis of black-box time-series models

- Developed a method to measure how much temporal context a time-series model uses to calculate its response to stimuli, based on a method originally devised for studying biological neurons
- Research areas: deep learning, automatic speech recognition, temporal processing, neural network function analysis

Open source neural data processing toolbox

- Collaborated in developing a neural data processing toolbox in python for time-series neural data
- Research areas: neuroscience, signal processing, signal filtering, data preprocessing, open source toolbox

Characterizing linguistic components in spoken word recognition

- Calculated where and how well different levels of linguistic information of speech are represented throughout the speech processing pathway
- Research areas: auditory neuroscience, linguistics, neurolinguistics, linear regression, representation analysis

Modeling spoken word recognition with automatic speech recognition

- Modeled the biological human speech processing pathway with end-to-end trained automatic speech recognition model (RNN-Transducer)
- Calculated where and how well different levels of linguistic information of speech are represented throughout the layers of the RNN-Transducer
- Research areas: neuroscience, linguistics, speech recognition, neural network representation analysis

INST. FOR RESEARCH IN FUNDAMENTAL SCIENCES | RESEARCH ASSISTANT

Tehran, Iran

Advisor: Dr. Reza Lashgari

Oct 2016—Jul 2017

- Analyzed similarity of features extracted from simultaneously recorded local field potential (LFP) and single unit activity (SUA) signals in primary visual cortex of macaque monkeys
- Research areas: visual neuroscience, signal processing, feature extraction

ACADEMIC HONORS AND AWARDS

COLUMBIA UNIVERSITY

New York, NY

MS Award of Excellence (awarded to fewer than 5% of the EE MS candidates) 2020

MS Armstrong Memorial Award (awarded to one outstanding EE MS candidate) 2019

MISCELLANEOUS

Tehran, Iran

33rd place in Iran's National University Entrance Exam (top 0.01%) 2012

Bronze medal in Iran's National Computer Olympiad 2011

PUBLICATIONS

JOURNALS

Gavin Mischler, Vinay Raghavan, [Menoua Keshishian](#), Nima Mesgarani. "[naplib-python: Neural Acoustic Data Processing and Analysis Tools in Python.](#)" *Software Impacts* (2023)

[Menoua Keshishian](#), Serdar Akkol, Jose Herrero, Stephan Bickel, Ashesh D Mehta, Nima Mesgarani. "[Joint, distributed and hierarchically organized encoding of linguistic features in the human auditory cortex.](#)" *Nature Human Behaviour* (2023)

Gavin Mischler, [Menoua Keshishian](#), Stephan Bickel, Ashesh D Mehta, Nima Mesgarani. "[Deep neural networks effectively model neural adaptation to changing background noise and suggest nonlinear noise filtering methods in auditory cortex.](#)" *NeuroImage* (2023)

[Menoua Keshishian](#), Hassan Akbari, Bahar Khalighinejad, Jose Herrero, Ashesh D Mehta, Nima Mesgarani. "[Estimating and interpreting nonlinear receptive field of sensory neural responses with deep neural network models.](#)" *eLife* (2020)

CONFERENCES

[Menoua Keshishian](#), Sam Norman-Haignere, Nima Mesgarani. "[Understanding Adaptive, Multiscale Temporal Integration In Deep Speech Recognition Systems.](#)" *Advances in Neural Information Processing Systems 34 (NeurIPS 2021)*

OPEN SOURCE CODE

Dynamic spectro-temporal receptive field analysis

github.com/naplab/DSTRF

A python library for dynamic spectro-temporal receptive field (dSTRF) analysis, an interpretable method for modeling stimulus-response mapping of biological neurons using feed-forward neural networks

Temporal context invariance analysis

github.com/naplab/PyTCI

A python library for measuring the amount of temporal context used by black-box time-series models, and how it changes based on the properties of the stimulus

Neural data processing toolbox

github.com/naplab/naplib-python

A python library for preprocessing, storing and analyzing time-series neural data (EEG/iEEG) aiming to facilitate research in the field of auditory neuroscience

Cognitive/behavioral experiments

github.com/menoua/cog-task

A (experimental) low-latency and cross-platform GUI application written in Rust that allows the user to define and execute a wide range of audiovisual stimulus presentation and behavioral tasks, organized in a tree-based ordering system, useful for cognitive neuroscience research

TEACHING EXPERIENCE

COLUMBIA UNIVERSITY | TEACHING ASSISTANT

New York, NY

Quantum Computing and Communication, Dr. Alexei Ashikhmin

Fall 2021

Sparse & Low-dimensional Models for High-dimensional Data, Dr. John Wright

Spring 2021

SHARIF UNIVERSITY OF TECHNOLOGY | TEACHING ASSISTANT

Tehran, Iran

Advanced Programming, Dr. Matin Hashemi

Spring, Fall 2016

Principles of Electronics, Dr. Mohammad Fakharzadeh

Spring, Fall 2015—2016

Computer Architecture, Dr. Matin Hashemi

Spring 2016

REFERENCES

DR. NIMA MESGARANI | ASSOCIATE PROFESSOR

Columbia University, Department of Electrical Engineering

nima@ee.columbia.edu

SELECTED COURSE PROJECTS

COLUMBIA UNIVERSITY

New York, NY

Speech & Audio Processing - Trained a CNN for instrument activity detection in polyphonic music

Natural Language Processing - Trained an LSTM for abstractive text summarization

Sparse & Low-dim Models for High-dim Data - Modeled dynamics of neural speech processing with convolutional sparse coding in MATLAB

Probabilistic Machine Learning - Modeled dynamics of neural speech processing using a Kalman filter with external inputs using the Pyro probabilistic programming library

Brain Computer Interfaces (BCI) Lab - Developed an online system to classify imagined hand movement from electroencephalography (EEG) with common spatial pattern (CSP) filters

Consciousness & Attention - Wrote a review paper: "On the Prospects of Artificial Consciousness"

Intro to Genomic Information Science - Trained a ResNet model to classify mixed patterns of proteins in confocal microscopy images of cells (a Kaggle competition)

SHARIF UNIVERSITY OF TECHNOLOGY

Tehran, Iran

Advanced Programming - Developed a database management system (DBMS) in Java with desktop, web, and Android interfaces

Microprocessors - Wrote a MATLAB-like matrix manipulation program in 8086 assembly

Operating Systems - Created a custom shell for Linux in C